

## E04: Context-free grammars

### solutions

#### E04-1: Solution:

- (a)  $\text{stmts} \rightarrow (\text{stmt} \text{ ";"})^*$
- (b)  $\text{stmts} \rightarrow \text{stmt} \text{ (" ;" stmt)}^*$
- (c)  $\text{stmts} \rightarrow [\text{stmt} \text{ (" ;" stmt)}^*]$

#### E04-2: Solution:

- (a)  $\text{stmts} \rightarrow \text{stmt} \text{ ";" stmts}$   
 $\text{stmts} \rightarrow \epsilon$
- (b)  $\text{stmts} \rightarrow \text{stmt} \text{ morestmts}$   
 $\text{morestmts} \rightarrow \text{" , " stmt morestmts}$   
 $\text{morestmts} \rightarrow \epsilon$
- (c)  $\text{stmts} \rightarrow \text{stmt} \text{ morestmts}$   
 $\text{stmts} \rightarrow \epsilon$   
 $\text{morestmts} \rightarrow \text{" , " stmt morestmts}$   
 $\text{morestmts} \rightarrow \epsilon$

#### E04-3: Solution:

- (a)  $\text{"((()) )", "(())()", "(()())", "()()()", "(()())"}$
- (b)  $\text{"()()()}"$

#### E04-4: Solution:

- $S \rightarrow \text{" (" S ") " S}$
- $S \rightarrow \epsilon$

#### E04-5: Solution:

$$\begin{aligned}
 E &\rightarrow T ( \text{"|"} T )^* \\
 T &\rightarrow F ( \text{"\&\&"} F )^* \\
 F &\rightarrow \text{"!" } F \mid \text{ID}
 \end{aligned}$$
**E04-6: Solution:**

$$\begin{aligned}
 \text{CallStmt} &\rightarrow \text{ID } \text{"(" } \text{ArgList } \text{"}")} \\
 \text{ArgList} &\rightarrow \epsilon \\
 \text{ArgList} &\rightarrow \text{Expr } \text{MoreExprs} \\
 \text{MoreExprs} &\rightarrow \epsilon \\
 \text{MoreExprs} &\rightarrow \text{"," } \text{Expr } \text{MoreExprs}
 \end{aligned}$$
**E04-7: Solution:**

$$\begin{aligned}
 S &\rightarrow \text{"b"} A \\
 S &\rightarrow \text{"a"} B \\
 A &\rightarrow \text{"a"} A \\
 A &\rightarrow \epsilon \\
 B &\rightarrow \text{"a"} B \\
 B &\rightarrow \text{"b"} C \\
 C &\rightarrow \epsilon
 \end{aligned}$$
**E04-8: Solution:**

- (a) {"a", "b", "\*", "(", ")", "|"}  
 (b) 
$$\begin{aligned}
 \text{expr} &\rightarrow \text{term } \text{"|"} \text{term}^* \\
 \text{term} &\rightarrow \text{factor } \text{term}^* \\
 \text{factor} &\rightarrow \text{"a"} \mid \text{"b"} \mid \text{factor } \text{"*"} \mid \text{"(" } \text{expr } \text{"}")}
 \end{aligned}$$